

June 18, 1998

Refer to: HNG-14

King K. Mak, P.E.
Research Engineer
The Texas A&M University System
Texas Transportation Institute
College Station, Texas 77843-3135

Dear Mr. Mak:

On June 9 you wrote to Mr. Henry Rentz, Director, Office of Engineering, requesting the Federal Highway Administration's (FHWA) acceptance of modifications to the Slotted Rail Terminal (SRT) design that was first approved as an National Cooperative Highway Report Program (NCHRP) Report 350 Test Level 3 (TL-3) terminal on December 4, 1995. Included with your request were copies of the Texas Transportation Institute report, "Optimization of the W-Beam Slotted Rail Terminal," dated May 1998, a composite video tape of the crash tests conducted, and drawings of the modified design.

This modified design, called the Improved Slotted Rail Terminal (ISRT-3), included a reduction in the end offset from 1.22 m to 0.91 m, a reduction in the length of the parabolic flare from 11.4 m to 8.9 m, an increase in the spacing between posts 3 to 9 from 0.95 m to 1.27 m, and the addition of a third set of 305-mm long slots in the second 3.81-m section of w-beam. In addition to these changes, the ISRT-3 uses redesigned slot guards, eliminates the w-beam backup plates, and specifies that the w-beam rail element be bolted to all posts except posts 7 and 8. Enclosure 1 shows the design and layout of the ISRT-3.

To support your request, you ran four full-scale crash tests: NCHRP Report 350 tests 3-30, 3-31, 3-34, and 3-35. All tests were run on the ISRT-3 design except 3-34 which was run on a similar design (called ISRT-4) having the original SRT-350 four-foot flare over its full 11.4-m length. Enclosure 2 contains the summaries of each of the four tests.

Based on our review of the information you sent, we agree that the ISRT-3, as tested, meets the evaluation criteria for an NCHRP Report 350 TL-3 terminal. Therefore, it may be used on the National Highway System (NHS) when it is specified by, or acceptable to, the responsible transportation agency. Because it remains a proprietary device, use of the ISRT-3 on Federal-aid projects, except exempt, non-NHS projects, is still subject to the conditions listed in Title 23, Code of Federal Regulations, Section 635.411.

You also requested that the ISRT-3 be accepted for use with any one of four different foundation tubes: 1.82-m or 1.98-m long steel tubes without soil plates, and 1.52-m or 1.37-m long steel tubes with soil plates. We agree that any one of these combinations may be used.

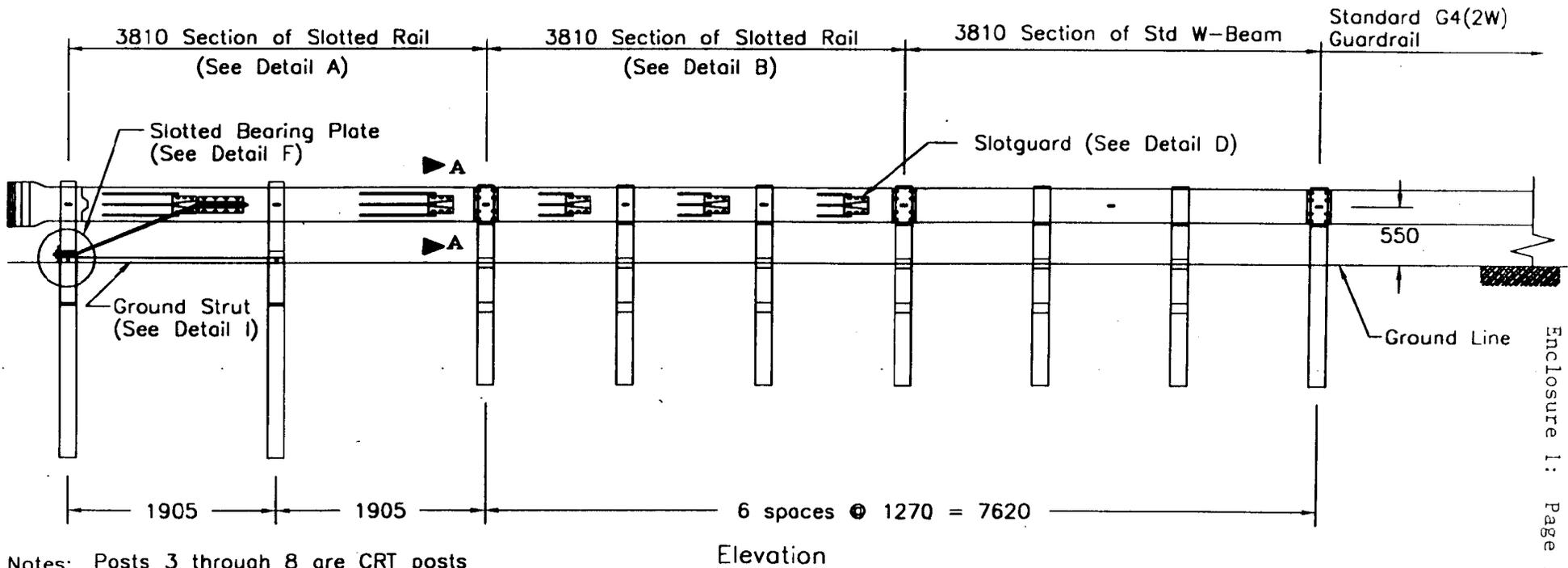
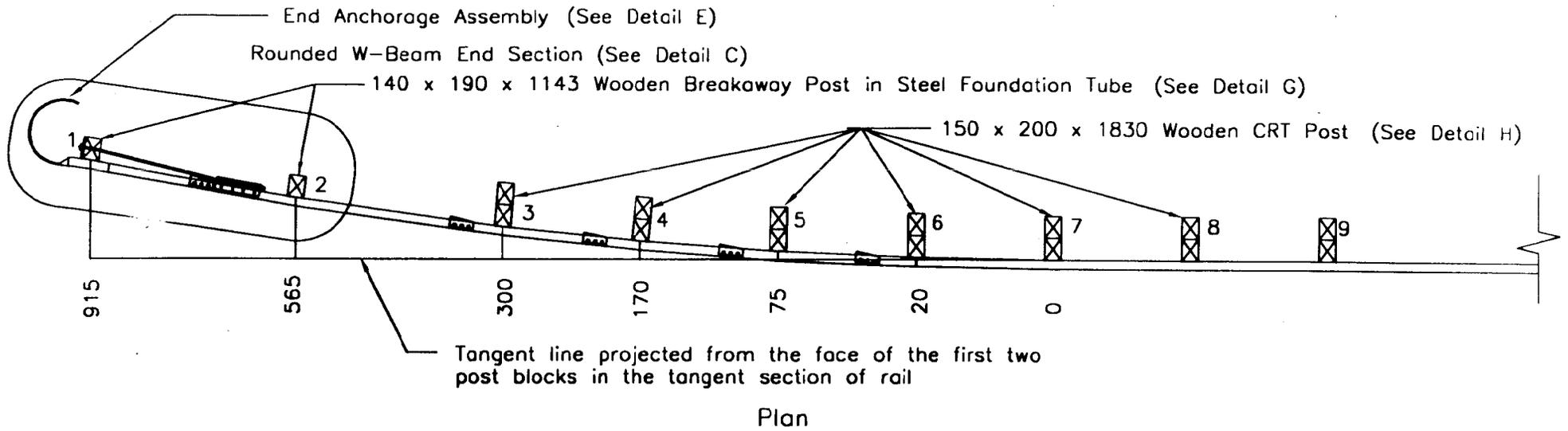
Please call Mr. Richard Powers at (202) 366-1320 if you have any questions on this action or if you wish to discuss any of the above in more detail.

Sincerely yours,

(original signed by Seppo I. Sillan)

for Dwight A. Horne
Chief, Federal-Aid and Design Division

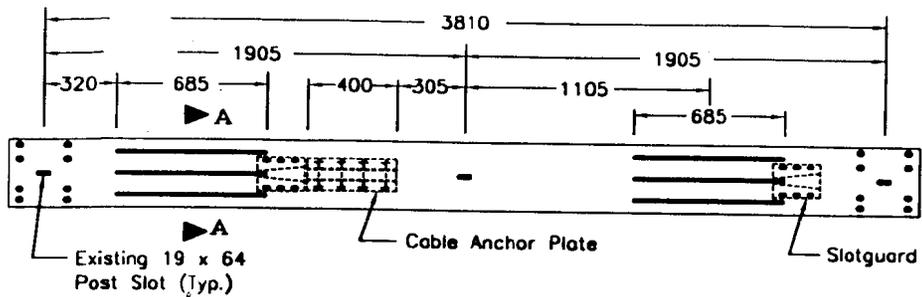
2 Enclosures
Acceptance Letter CC-51



Notes: Posts 3 through 8 are CRT posts
 Posts 7 and 8 not connected to rail

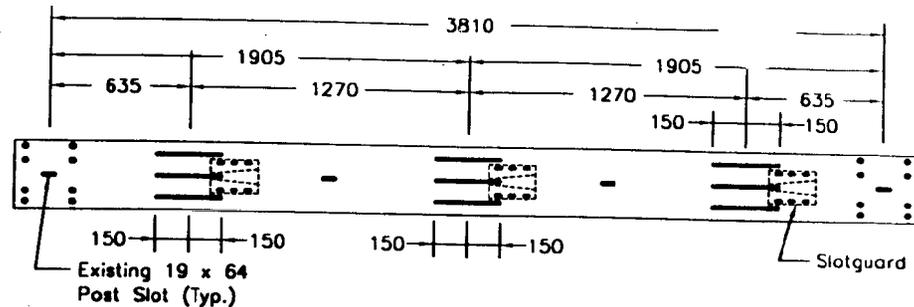
Modified SRT w/ 0.9m Offset

Revised on 5/4/98.



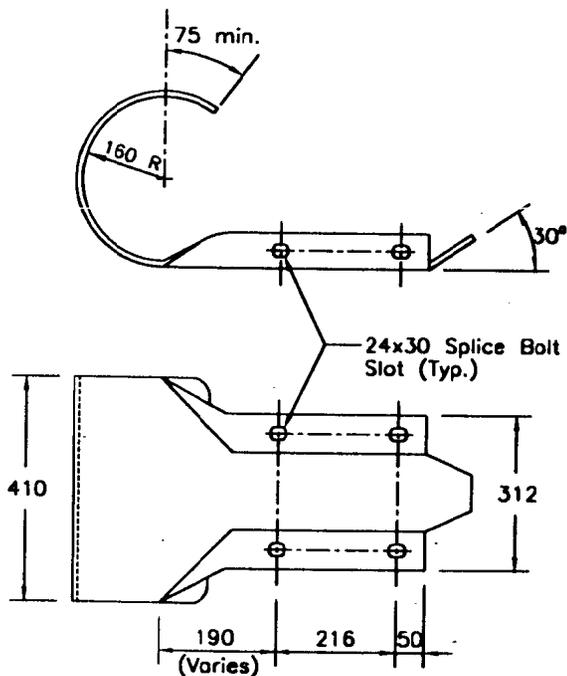
Note: At Location shown, cut three 13 mm slots. One on each peak and one in the valley of the W-beam.

DETAIL A
3810 SLOTTED RAIL ELEMENT

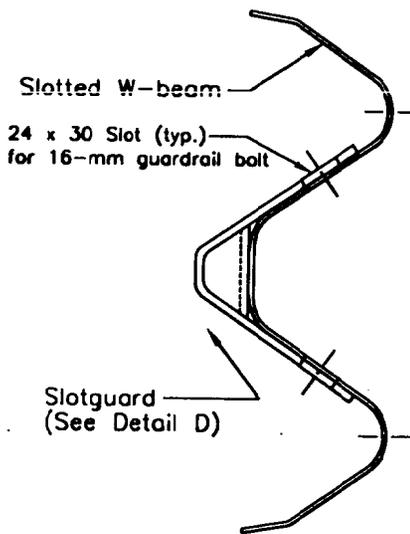


Note: At Location shown, cut three 13 mm slots. One on each peak and one in the valley of the W-beam.

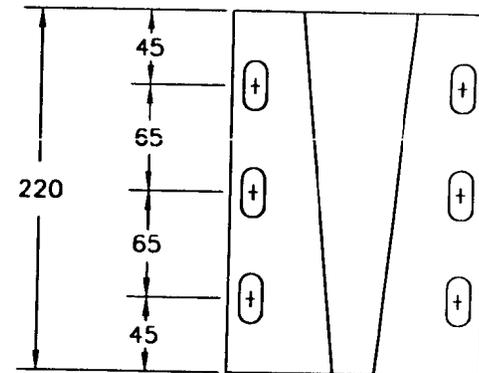
DETAIL B
3810 SLOTTED RAIL ELEMENT



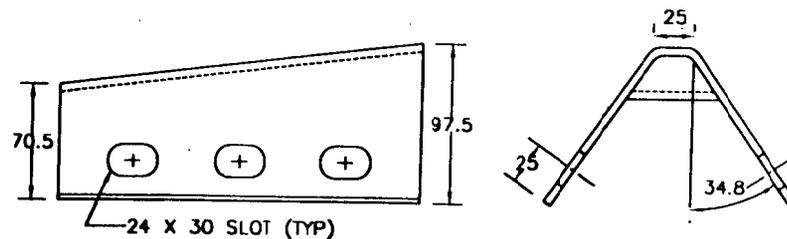
DETAIL C
ROUNDED W-BEAM END SECTION



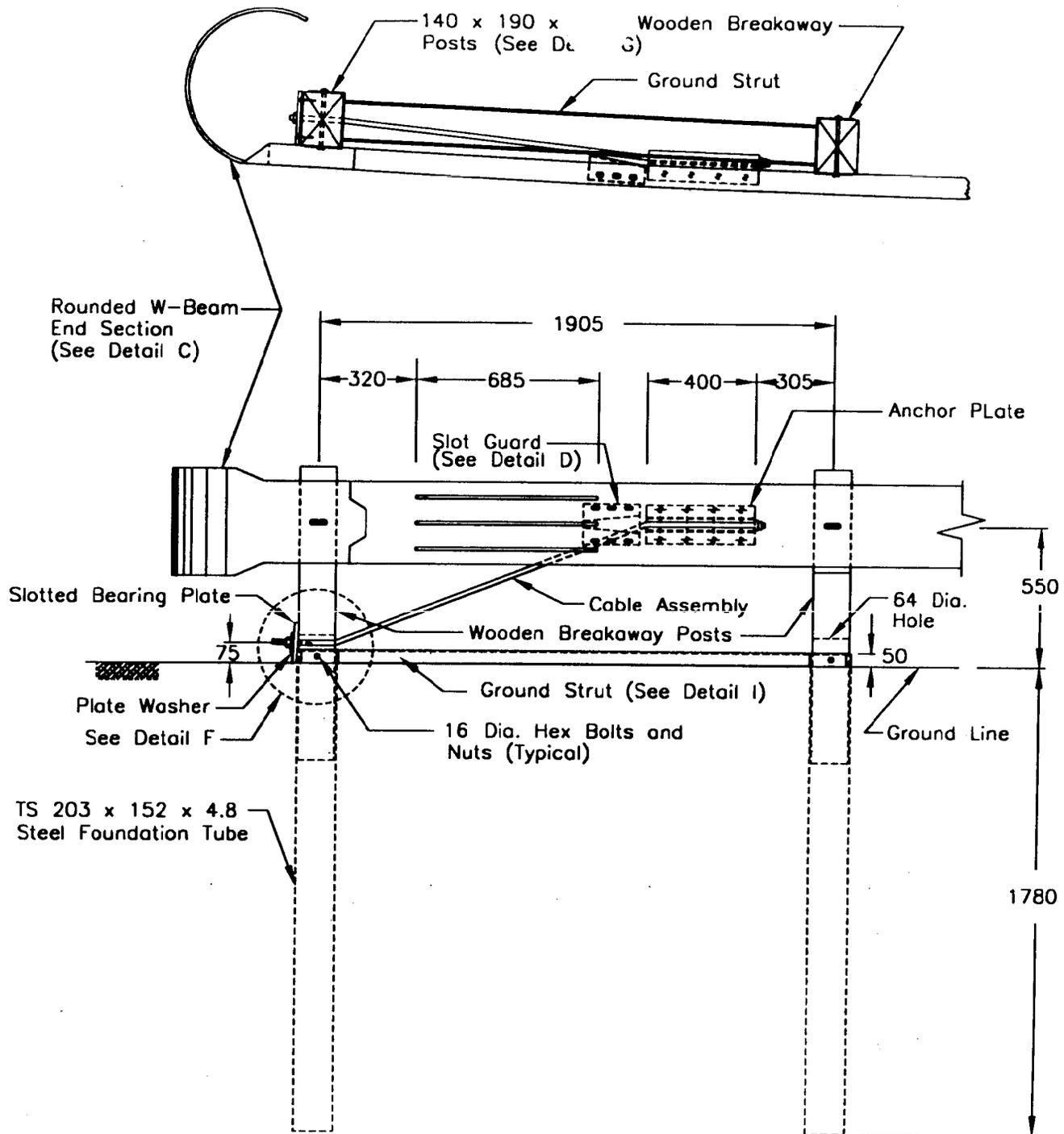
SECTION A-A



DETAIL D
SLOTGUARD

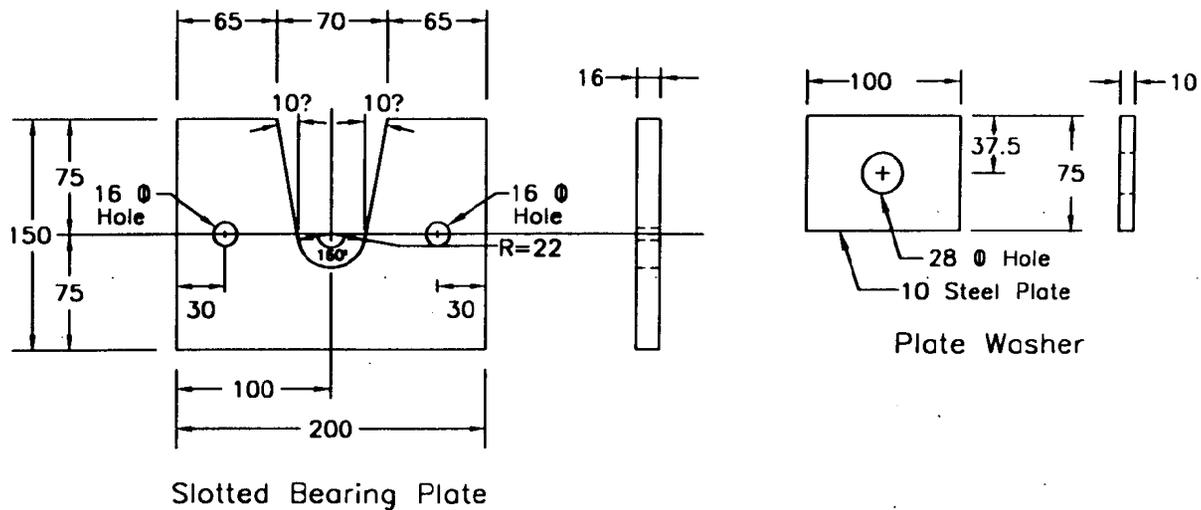
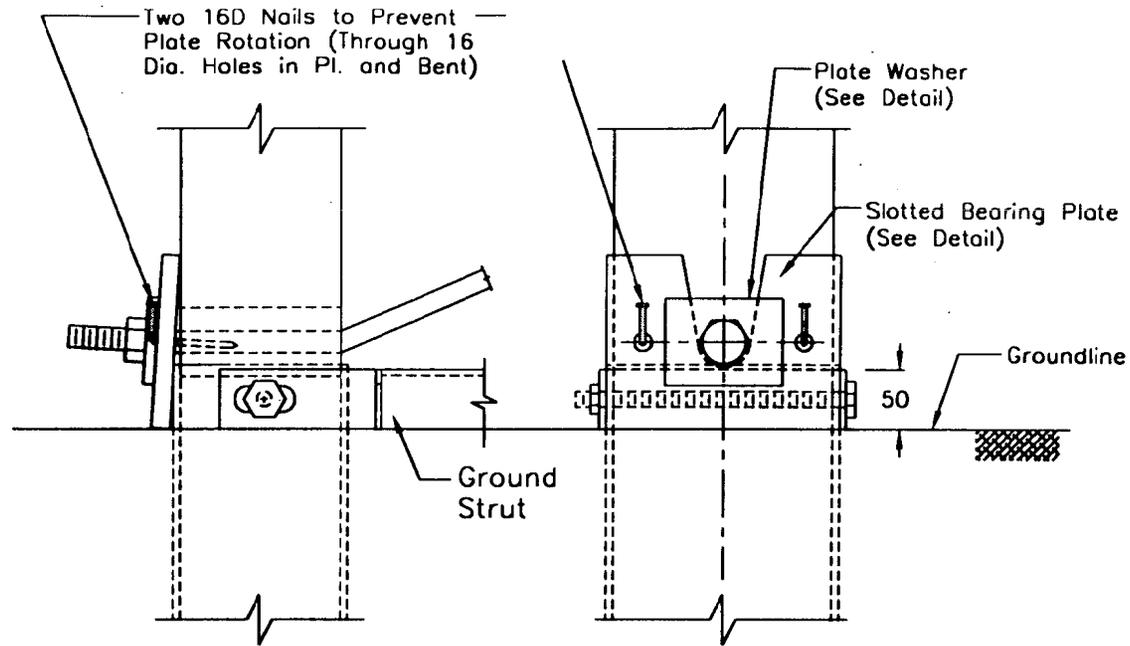


Revised on 5/4/98



DETAIL E
END ANCHORAGE ASSEMBLY

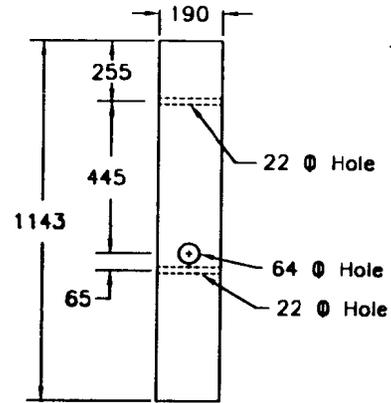
Revised on 5/4/98



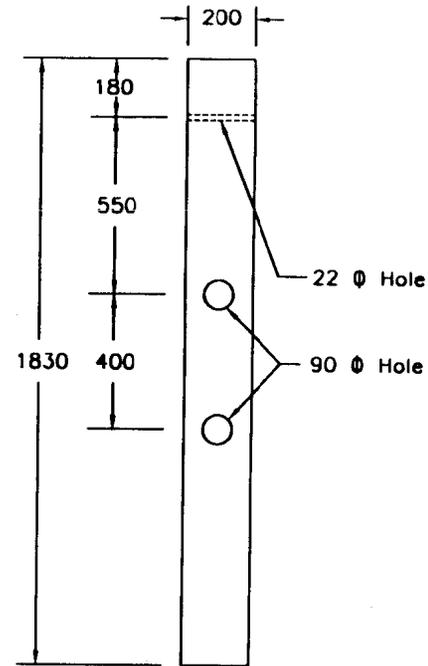
Slotted Bearing Plate

DETAIL F
SLOTTED BEARING PLATE

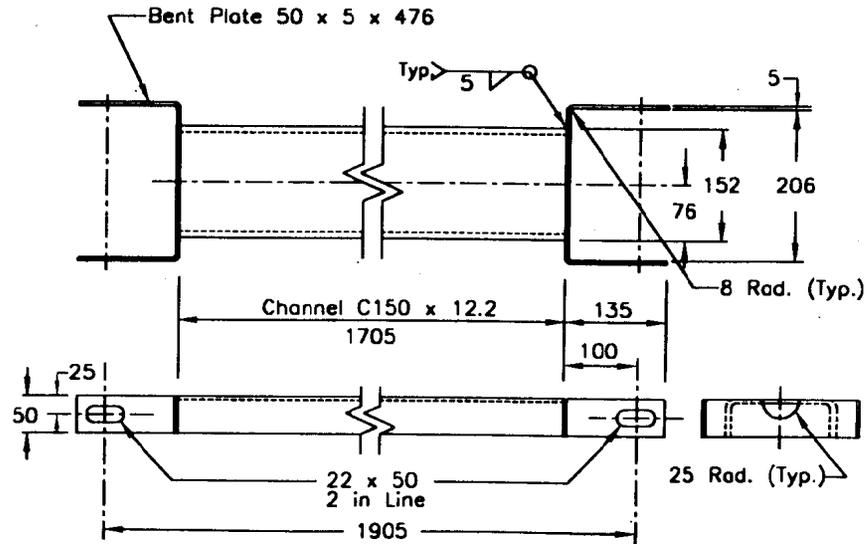
REVISED ON 5/4/98



DETAIL G
SHORT BREAKAWAY WOODEN POST

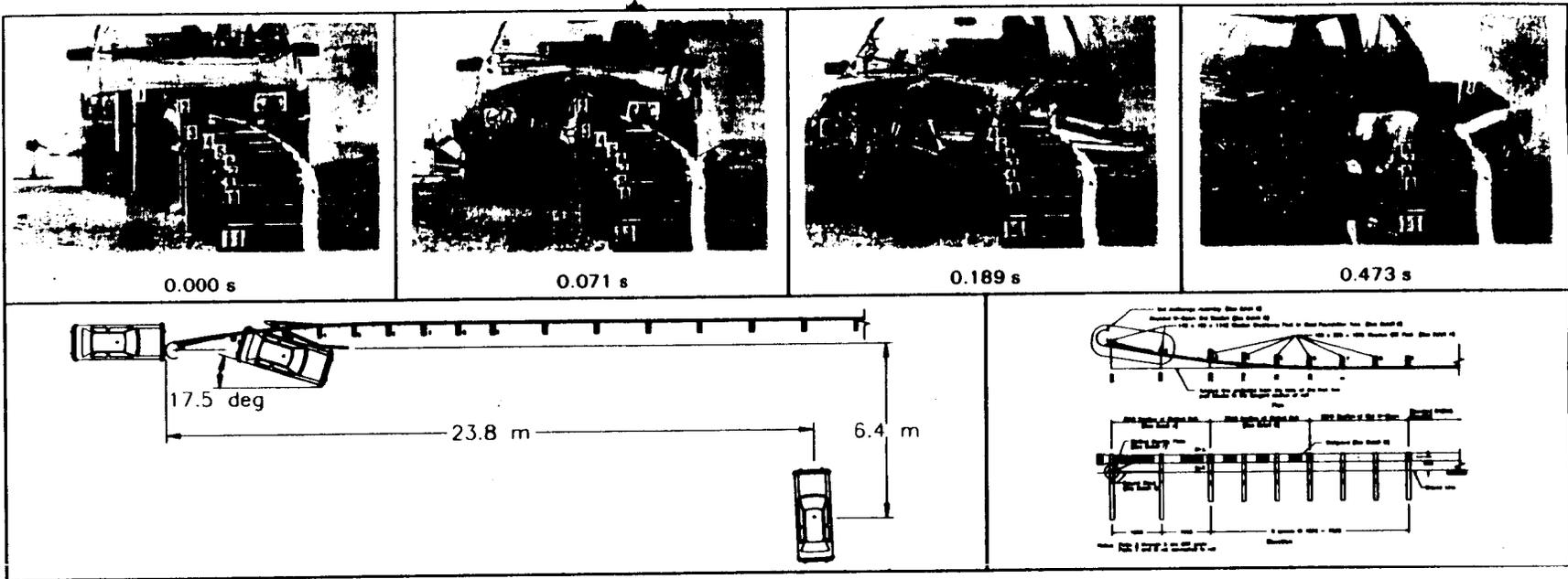


DETAIL H
WOODEN CRT POST



DETAIL I
GROUND STRUT

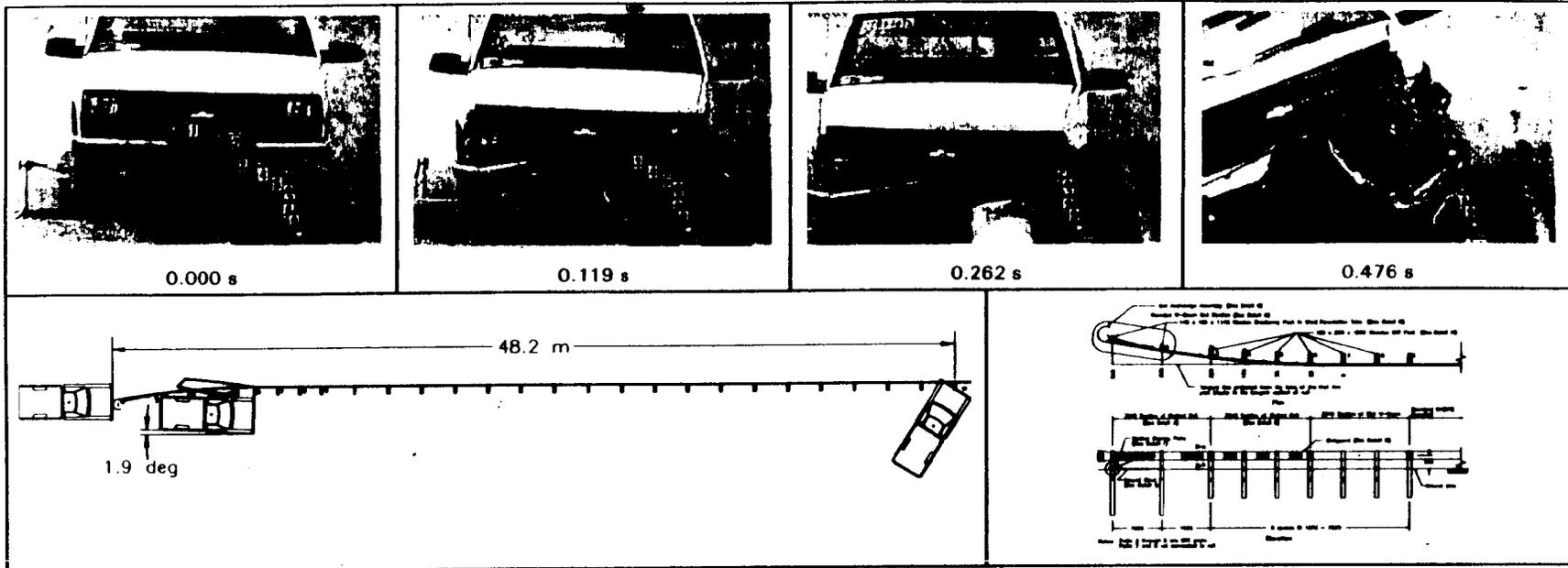
Revised on 5/4/98



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General Information		Impact Conditions		Test Article Deflections (m)	
Test Agency	Texas Transportation Institute	Speed (km/h)	99.4	Dynamic	7.01
Test No.	220546-6	Angle (deg)	0.0	Permanent	3.80
Date	04/08/98	Exit Conditions		Vehicle Damage	
Test Article		Speed (km/h)	43.6	Exterior	
Type	Terminal	Angle (deg)	17.5	VDS	12FL4
Name	Improved SRT	Occupant Risk Values		CDC	12YZEW3
Installation Length (m)	53.3	Impact Velocity (m/s)		Maximum Exterior	
Material or Key Elements	Slotted W-beam guardrail with 915 mm flare	x-direction	6.8	Vehicle Crush (mm)	300
Soil Type and Condition	Standard Soil, Dry	y-direction	3.4	Interior	
Test Vehicle		THIV (km/h)	24.8	OCDI	LS0000000
Type	Production	Ridedown Accelerations (g's)		Max. Occ. Compart.	
Designation	820C	x-direction	-13.5	Deformation (mm)	17
Model	1993 Ford Festiva	y-direction	11.8	Post-Impact Behavior	
Mass (kg) Curb	856	PHD (g's)	15.3	(during 1.0 s after impact)	
Test Inertial	820	ASI	0.8	Max. Yaw Angle (deg)	27
Dummy	76	Max. 0.050-s Average (g's)		Max. Pitch Angle (deg)	-2
Gross Static	896	x-direction	-7.7	Max. Roll Angle (deg)	7
		y-direction	6.3		
		z-direction	-1.5		

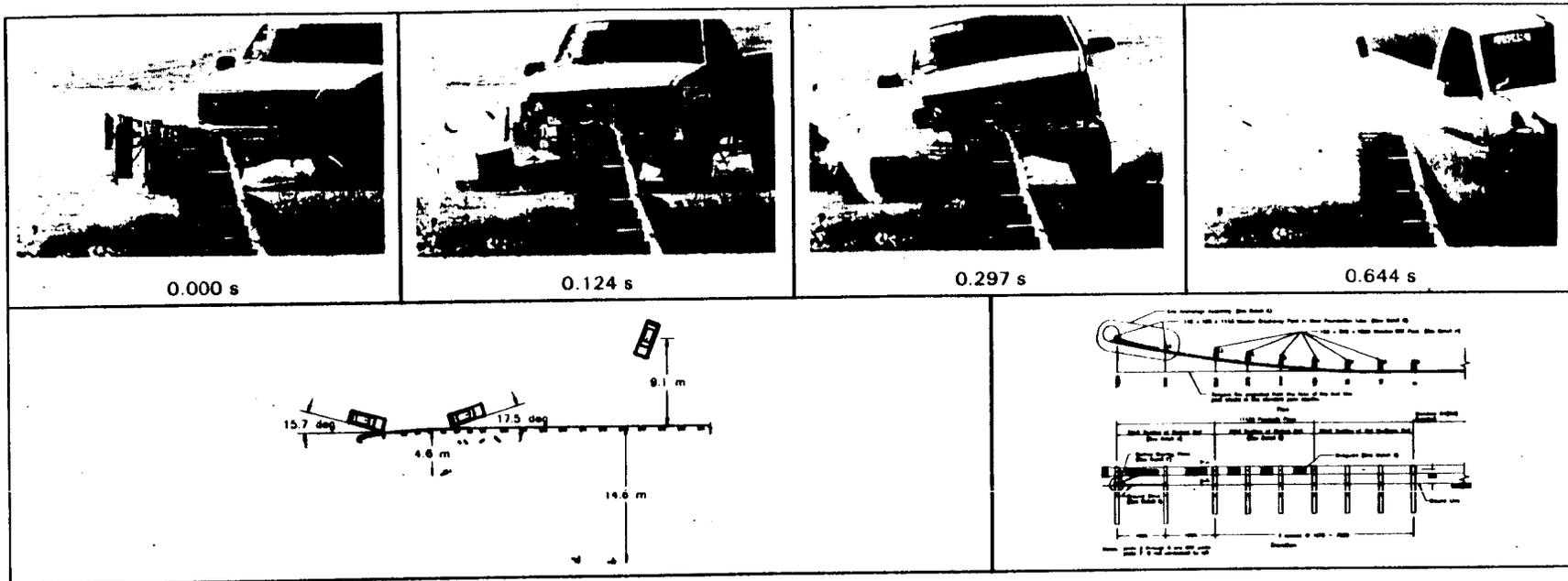
Figure 19. Summary of results for test 220546-6, NCHRP Report 350 test 3-30.



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General Information		Impact Conditions		Test Article Deflections (m)	
Test Agency	Texas Transportation Institute	Speed (km/h)	100.6	Dynamic	7.23
Test No.	220546-5	Angle (deg)	0.0	Permanent	3.94
Date	04/02/98	Exit Conditions		Vehicle Damage	
Test Article		Speed (km/h)	77.1	Exterior	
Type	Terminal	Angle (deg)	1.9	VDS	12FD2
Name	Improved SRT	Occupant Risk Values		CDC	12FDEW2
Installation Length (m)	53.3	Impact Velocity (m/s)		Maximum Exterior	
Material or Key Elements	Slotted W-beam guardrail with 915 mm flare	x-direction	5.0	Vehicle Crush (mm)	270
Soil Type and Condition	Standard Soil, Dry	y-direction	1.5	Interior	
Test Vehicle		THIV (km/h)	18.2	OCDI	FS0000000
Type	Production	Ridedown Accelerations (g's)		Max. Occ. Compart.	
Designation	2000P	x-direction	-4.4	Deformation (mm)	25
Model	1995 Chevrolet 2500 pickup truck	y-direction	-2.8	Post-Impact Behavior	
Mass (kg) Curb	1898	PHD (g's)	5.1	(during 1.0 s after impact)	
Test Inertial	2000	ASI	0.4	Max. Yaw Angle (deg)	-12
Dummy	No dummy	Max. 0.050-s Average (g's)		Max. Pitch Angle (deg)	-6
Gross Static	2000	x-direction	-4.6	Max. Roll Angle (deg)	34
		y-direction	-1.6		
		z-direction	-1.9		

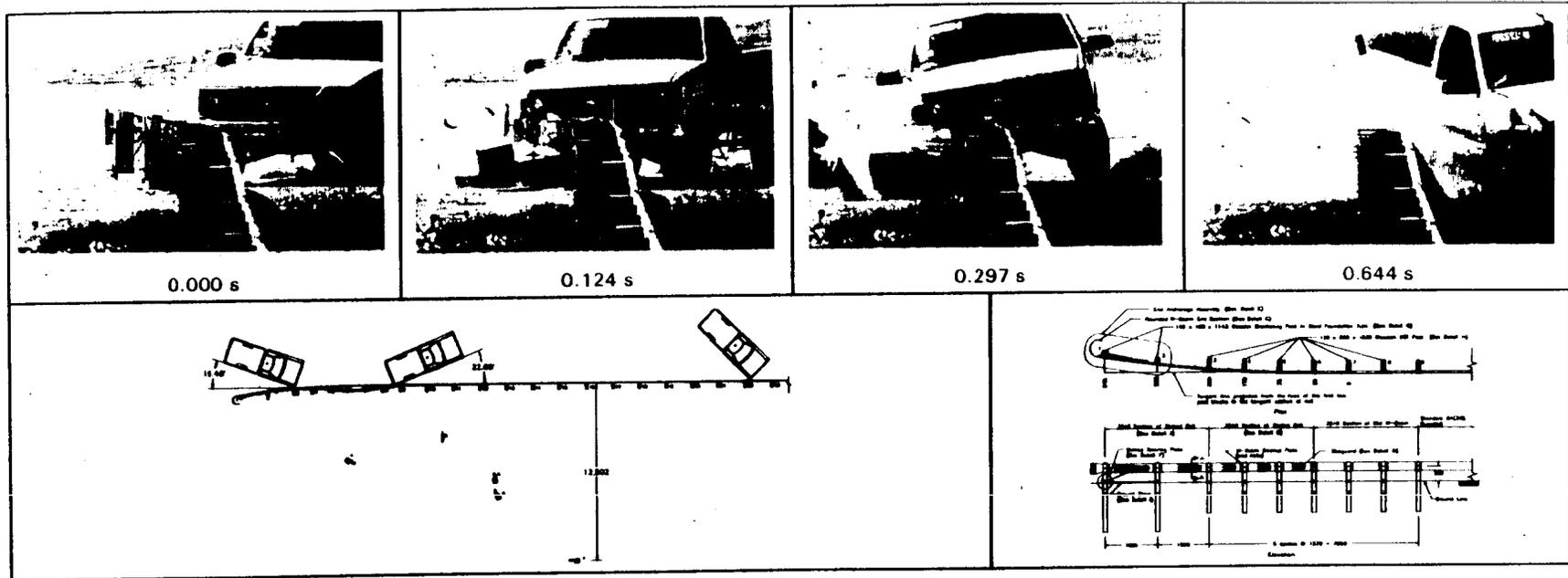
Figure 11. Summary of results for test 220546-5, NCHRP Report 350 test 3-31.



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<p>General Information</p> <p>Test Agency Texas Transportation Institute</p> <p>Test No. 220546-8</p> <p>Date 05/19/98</p> <p>Test Article</p> <p>Type Terminal</p> <p>Name Improved SRT</p> <p>Installation Length (m) 53.3</p> <p>Material or Key Elements Slotted W-beam guardrail with 1220 mm flare</p> <p>Soil Type and Condition Standard Soil, Dry</p> <p>Test Vehicle</p> <p>Type Production</p> <p>Designation 2000P-320C</p> <p>Model 1994 Geo Metro</p> <p>Mass (kg) Curb 770</p> <p> Test Inertial 820</p> <p> Dummy 75</p> <p> Gross Static 895</p>	<p>Impact Conditions</p> <p>Speed (km/h) 101.1</p> <p>Angle (deg) 15.7</p> <p>Exit Conditions</p> <p>Speed (km/h) 57.4</p> <p>Angle (deg) 17.5</p> <p>Occupant Risk Values</p> <p>Impact Velocity (m/s)</p> <p> x-direction 8.3</p> <p> y-direction 4.7</p> <p>THIV (km/h) 26.0</p> <p>Ridedown Accelerations (g's)</p> <p> x-direction -9.1</p> <p> y-direction -10.9</p> <p>PHD (g's) 13.8</p> <p>ASI 0.8</p> <p>Max. 0.050-s Average (g's)</p> <p> x-direction -6.8</p> <p> y-direction -5.0</p> <p> z-direction -2.7</p>	<p>Test Article Deflections (m)</p> <p>Dynamic 0.94</p> <p>Permanent 0.52</p> <p>Vehicle Damage</p> <p>Exterior</p> <p> VDS 01FR4</p> <p> CDC 01FZEW4</p> <p>Maximum Exterior</p> <p> Vehicle Crush (mm) 320</p> <p>Interior</p> <p> OCDI RS0010000</p> <p>Max. Occ. Compart.</p> <p> Deformation (mm) 40</p> <p>Post-Impact Behavior (during 1.0 s after impact)</p> <p>Max. Yaw Angle (deg) 35</p> <p>Max. Pitch Angle (deg) 2</p> <p>Max. Roll Angle (deg) 8</p>
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Figure 35. Summary of results for test 220546-8, NCHRP Report 350 test 3-34.



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General Information		Impact Conditions		Test Article Deflections (m)	
Test Agency	Texas Transportation Institute	Speed (km/h)	99.2	Dynamic	1.01
Test No.	220546-7	Angle (deg)	19.5	Permanent	0.71
Date	04/24/98	Exit Conditions		Vehicle Damage	
Test Article		Speed (km/h)	28.3	Exterior	
Type	Terminal	Angle (deg)	22.1	VDS	01FL4
Name	Improved SRT	Occupant Risk Values		CDC	01ZYEW3
Installation Length (m)	53.3	Impact Velocity (m/s)		Maximum Exterior	
Material or Key Elements	Slotted W-beam guardrail with 915 mm flare	x-direction	6.6	Vehicle Crush (mm)	585
Soil Type and Condition	Standard Soil, Dry	y-direction	4.5	Interior	
Test Vehicle		THIV (km/h)	23.0	OCDI	RS0000000
Type	Production	Ridedown Accelerations (g's)		Max. Occ. Compartment Deformation (mm)	
Designation	2000P	x-direction	-7.6	10	
Model	1995 Chevrolet 2500 pickup truck	y-direction	-6.9	Post-Impact Behavior	
Mass (kg) Curb	2062	PHD (g's)	10.6	(during 1.0 s after impact)	
Test Inertial	2000	ASI	0.8	Max. Yaw Angle (deg)	-40
Dummy	No dummy	Max. 0.050-s Average (g's)		Max. Pitch Angle (deg)	-5
Gross Static	2000	x-direction	-5.3	Max. Roll Angle (deg)	8
		y-direction	-5.6		
		z-direction	4.1		

Figure 27. Summary of results for test 220546-7, NCHRP Report 350 test 3-35.